Fermilab
PPD/MD/Engineering Analysis Group

A Glue Force Estimation Comment
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Introduction

I've looked at Vic's calculation for the "Variation of Glue Force __Shear Force". It seems to me that the shear stress is very small even for the 5 mm offset. The max shear is 1,600*2.2/(17.5*17.5*40*40)=0.008 psi. If I count the normal force as shear too, the stress will be 20000*2.2/(17.5*17.5*40*40)=0.09 psi
It is still very low.

## Alternative Way to Estimate the Glue Force

Case (n): Full strength design

Assuming we design a glue joint as strong as PVC (design a weld as strong as the parent material). When the structure fails, the PVC will fail first before the glue joint. Then, it becomes very simple since the shear strength will be one half of the tensile strength. We're looking for the glue has **a minimum shear strength** at 0.5 *6100=3,000 psi. We're done.

Case (n+1): Based on the vertical extraction subjected to 21 psi

We want to design a structure where the vertical and horizontal extrusion bonded together without any slippage during the loading. First, we've learned that the wall thickness is determined by the vertical extrusion subjected to 21 psi (under the 1800 psi working stress limit). During the operation, the vertical cell with 21 psi pressure pushes the side wall bowls outward. If the horizontal extrusion does not glue well to the vertical one, they will open up and slide each other as two individual beams. So question is how strong the glue has to be to maintain these two beams as ONE Piece? What's shear stress in the glue layer? For the two beams bonding together, the maximum shear force (take 1" depth) for one cell

$$V \ max=21*4 \ cm/2.54/2=16.53 \ lb$$
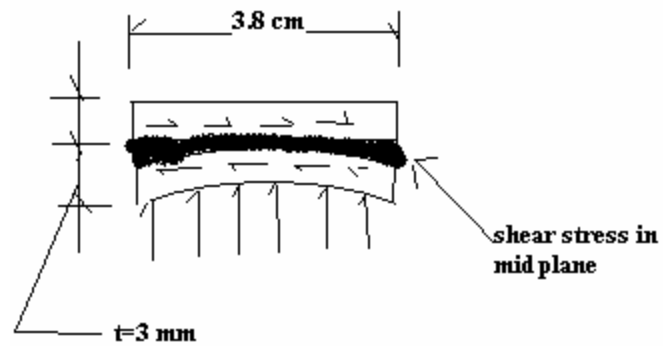
Max Shear stress is located at the center of the beam (glue layer)

S(max)=3/2*V/A=1.5*16.53/(2*3mm/25.4)=105 psi. for (100% contact)
                                                210 psi   for (50 % contact)

Assuming a safety factor of 2, we're looking for a glue strength= 420 psi at least (for a 50% contact)